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METHODS AND SYSTEMS FOR IDENTIFYING, REDIRECTING, AND PROCESSING MESSAGES OF DIFFERENT SS7 PROTOCOL VARIATIONS

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Description

METHODS AND SYSTEMS FOR IDENTIFYING, REDIRECTING, AND PROCESSING MESSAGES OF DIFFERENT SS7 PROTOCOL VARIATIONS

Technical Field

The present invention relates to methods and systems for identifying, redirecting, and processing messages of different SS7 protocol variations. More particularly, the present invention relates to methods and systems for identifying SS7 messages to be redirected to a service control point of one SS7 protocol variation and for inserting an indicator in the message to identify the protocol variation of the SS7 message that allows the service control point to process the message.

Background Art

SS7 is a signaling protocol used internationally to establish and tear down calls and to query databases for information relating to calls and subscribers. However, different countries use different variations of the SS7 protocol. For example, in the United States, ANSI SS7 is the dominant signaling protocol. In Europe, individual countries use ITU-N SS7 for signaling in networks within the countries. For signaling between countries, the ITU-I

SS7 protocol is used. Each of these SS7 protocol variations include different message formats. Within national networks, signaling nodes, such as signal transfer points and service control points, are typically configured to recognize only one SS7 protocol variation. Gateway nodes are placed between networks to convert from one SS7 protocol variation to another protocol variation. However, these gateway nodes are simply protocol converters. These protocol converters do not have the capability to intelligently redirect or process messages based on SS7 protocol variation.

In some instances, it may be desirable to redirect messages to a service control point of a particular SS7 protocol variation. For example, as illustrated in Figure 1, an ANSI STP **100** is connected to an ANSI SCP **102** and an ANSI SS7 network **104**. In one processing scenario, it may be desirable to allow calls from ANSI SS7 network **104** to be completed only during certain times of day. The times of day that calls are allowed may be stored in ANSI SCP **102**. Accordingly, when ANSI SS7 network **104** sends an ANSI ISUP message to a destination end office, ANSI STP **100** may redirect the ISUP message to ANSI SCP **102** to determine whether the call should be allowed. This redirection may be accomplished by encapsulating the ANSI ISUP message in an SCCP unit data message, which is in turn encapsulated in an MTP message. ANSI SCP **102** receives the encapsulated message, determines whether the call should be completed, and if the call is allowed, forwards the ISUP message to its intended destination.

Conventional STP redirect functions are capable of redirecting messages formatted according to a single SS7 protocol variation. Thus, when ANSI STP **100** illustrated in Figure 1 receives an ITU-N message or ITU-I ISUP message, the message would be discarded. Discarding messages relating to a call is undesirable, since the calls would not be completed. Accordingly, there exists a need for improved methods and systems for identifying, redirecting, and processing messages of different SS7 protocol variations.

Disclosure of the Invention

The present invention includes methods and systems for identifying, redirecting, and processing messages of different SS7 protocol variations. In one example, a signaling message routing node receives an ISUP message of one SS7 protocol variation. The signaling message routing node determines whether the message should be redirected to a service control point. The signaling message routing node also identifies the SS7 protocol variation of the ISUP message. The signaling message routing node then encapsulates the ISUP message in an SCCP message. The SCCP message is then encapsulated in an MTP message. The SCCP and MTP messages may be formatted according to a predetermined SS7 protocol variation.

According to one important aspect of the invention, the signaling message routing node identifies the protocol variation of the original ISUP message and inserts an indicator of that protocol variation in the encapsulating SCCP message. This indicator allows the receiving node to properly decode and process the encapsulated message, even if the receiving node uses a

different protocol variation than the protocol variation of the encapsulated message for external communications. For example, if the original ISUP message is an ITU-N ISUP message and the message is being sent to an SCP that uses ANSI SS7, the ITU-N ISUP message may be encapsulated in an ANSI SCCP packet and an ANSI MTP-3 packet. However, in the ANSI SCCP packet, the signaling message routing node may insert an indicator that indicates that the payload is ITU-N. The signaling message routing node may then forward the encapsulated ITU-N message to the ANSI SCP. The ANSI SCP may then decode the encapsulating SCCP message and identify the protocol variation of the payload. Since the ANSI SCP knows the protocol variation of the payload, the SCP may then decode the payload using the ITU-N protocol. The SCP may then determine whether the payload message should be forwarded to its destination.

In an alternate implementation of the invention, rather than redirecting only ISUP messages, the multi-protocol redirect function of the present invention may be used to redirect SCCP messages to SCPs for providing an appropriate database service. In performing multi-SS7-variation SCCP message redirection, received SCCP messages may be encapsulated in SCCP and MTP-3 headers of a predetermined protocol type. The SCCP message may indicate the protocol variation of the payload. The receiving node may decode and process the payload using the protocol variation indicator.

In yet another implementation of the invention, rather than having a single SCP capable of decoding payloads having multiple SS7 protocol variations, an STP may be connected to SCPs of different protocol variations

and may redirect the message to the SCP of the appropriate protocol variations. In this scenario, the protocol indicator would not be required to be sent in the message because the message would be formatted according to the appropriate SS7 protocol variation and sent to the appropriate SCP.

Accordingly, it is an object of the invention to provide methods and systems for identifying, redirecting, and processing messages of different SS7 protocol variations.

It is another object of the invention to provide methods and systems for processing SS7 messages of different SS7 protocol variations based on indicator inserted in the SS7 messages.

Some of the objects of the invention having been stated hereinabove, and which are addressed in whole or in part by the present invention, other objects will become evident as the description proceeds when taken in connection with the accompanying drawings as best described hereinbelow.

Brief Description of the Drawings

Preferred embodiments of the invention will now be explained with reference to the accompanying drawings of which:

Figure 1 is a block diagram illustrating message redirection in a conventional SS7 network that utilizes a single variation of the SS7 protocol;

Figure 2 is a block diagram illustrating message redirection using a signal transfer point capable of identifying and redirecting messages of different SS7 protocol variations and a service control point capable of processing SS7

messages of different SS7 protocol variations according to an embodiment of the present invention;

Figure 3 is a block diagram illustrating an exemplary internal architecture of a signal transfer point capable of identifying and redirecting SS7 messages of different SS7 protocol variations according to an embodiment of the present invention;

Figure 4 is a block diagram illustrating exemplary processing at an inbound link interface module for SS7 messages of different SS7 protocol variations according to an embodiment of the present invention;

Figure 5 is block diagram illustrating exemplary processing at an outbound link interface module for SS7 messages of different protocol variations according to an embodiment of the present invention; and

Figure 6 illustrates an alternate embodiment of the invention in which an STP of the present invention is configured to identify SS7 messages of different protocol variations and to direct these messages to SCPs of the appropriate protocol variation and/or service type.

Detailed Description of the Invention

Figure 2 illustrates a network including an STP **200** capable of identifying and redirecting SS7 messages of different SS7 protocol variations and an SCP **202** capable of processing SS7 messages redirected by STP **200**. In the illustrated example, STP **200** is connected to ANSI SS7 network **204**, an ITU-I network **206**, and an ITU-N network **208**. STP **200** is preferably capable

of receiving SS7 messages from all three types of networks, identifying the SS7 protocol variations of the messages, redirecting predetermined SS7 messages to SCP **202** and including an indicator in the redirected messages that indicates the SS7 protocol variation of each message. STP **200** and SCP **202** communicate using one SS7 protocol variation. In the illustrated example, the SS7 protocol variation used for communications between STP **200** and SCP **202** is assumed to be the ANSI SS7 protocol. However, SCP **202** is also capable of decoding encapsulated messages received from STP **200** of different SS7 protocol variations using the indicators provided by STP **200**.

In the illustrated example, ITU-I SS7 network **206** is assumed to send an ITU-I ISUP message to STP **200**. The ITU-I ISUP message may be addressed to the point code of an end office in ITU-N network **208**. Because the operators of networks **206** and **208** may only allow calls to be completed between their networks during certain time periods, STP **200** may redirect the ITU-I message to SCP **202**. Identifying whether the message should be redirected may be performed using gateway screening and a redirect table associated with gateway screening. The parameters used to identify whether the message should be redirected may include the OPC, the DPC, and the service indicator. Once STP **200** identifies the message as a candidate for redirection, STP **200** encapsulates the message in an ANSI SCCP packet and encapsulates the ANSI SCCP packet in an ANSI MTP-3 packet. It is understood that the SCCP and MTP-3 encapsulation may be performed in a single step. STP **200** preferably also inserts an indicator in the message that communicates to SCP

202 that the message payload is ITU-I ISUP. This indicator may be inserted in any unused field in the message. In one example, the SS7 protocol variation indicator may be inserted in the calling party subsystem number of the encapsulating SCCP message. For example, the subsystem number may be set to "0" for ANSI format or "1" for ITU format. The network indicator parameter in the ISUP message may be used to indicate whether an ITU ISUP message is of the ITU-N protocol or the ITU-I protocol.

Upon receiving the message, SCP **202** examines the protocol variation indicator and determines the SS7 protocol variation of the payload message. The indicator inserted by STP **200** enables SCP **202** to decode ISUP and other message types of different SS7 protocol variations while only being required to implement external message routing and SCCP connection control in one of the variations.

The present invention is not limited to using a protocol variation indicator in a message to indicate the SS7 protocol variation to an SCP. In an alternate implementation, rather than inserting an indicator in an unused field or fields of a redirected message, STP **200** may have different links or linksets connected to SCP **202**, where each linkset corresponds to a particular protocol variation. STP **200** may be configured to redirect ITU-I ISUP messages over one linkset, ITU-N ISUP messages over another linkset, and ANSI ISUP messages to SCP **202** over yet another linkset. SCP **202** would then know how to process the messages based on the linkset from which the messages were received. In

this example, STP **200** preferably still encapsulates the ISUP messages in ANSI SCCP and MTP packets.

Figure 3 illustrates an exemplary internal architecture for STP **200** for identifying and redirecting SS7 messages having multiple different SS7 protocol variations. Referring to Figure 3, STP **200** includes a plurality of internal processing cards or modules connected by a pair of buses. In the illustrated example, these modules include a link interface module **302**, a data communications module **304**, and database services modules (DSMs) **306** and **308**. The modules are connected by a pair of counter-rotating ring buses **310**.

Link interface module **302** is configured to send and receive SS7 messages over SS7 signaling links. Accordingly, link interface module **302** includes SS7 level 1 and 2 function **312** for performing SS7 level 1 and 2 functions, such as error detection, error correction, and sequencing. Gateway screening function **314** screens messages based on one or more parameters in the messages to determine whether to allow the messages into the network. In addition, gateway screening function **314** identifies messages as redirection candidates. As discussed above, gateway screening function **314** may use the OPC, the DPC, and the service indicator to determine whether a message is a candidate for redirection. Multi-SS7-variation ID/redirection function **316** receives messages identified as redirection candidates, encapsulates the messages in an SCCP and MTP packets of an SS7 protocol variation, inserts a protocol variation indicator in the packets, and forwards the packets to discrimination function **318**. Discrimination function **318** determines whether

received messages should be passed to routing function **320** for routing to an appropriate outbound signaling link or to distribution function **318** to be distributed internally for further processing. This determination may be made based on the destination point code in the message. Routing function **322** routes messages identified as requiring external routing. Distribution function **320** distributes messages identified as requiring further internal processing by STP **200**.

Data communications module **304** includes functions for sending and receiving SS7 messages over IP signaling links. In the illustrated example, these modules include a physical layer function **324** for performing OSI physical layer functions, such as modulating data signals onto a carrier for transmission over a physical medium. Datalink function **326** performs OSI datalink functions, such as ensuring reliable communications between directly connected nodes. Network function **328** performs network layer routing, such as IP routing. Transport function **330** performs transport layer functions, such as connection management, reliable end-to-end delivery of messages and flow control. SS7 adapter layer **332** includes functions for sending and receiving SS7 messages over an underlying IP network. SS7 adapter layer **332** may implement M2PA, M3UA, M2UA, SUA, or any other suitable SS7 adapter layer protocol. Functions **314-322** perform similar functions to the correspondingly numbered components described above with regard to LIM **302**.

DSMs **306** and **308** may perform various database services, such as global title translation and number portability translation. In the illustrated

example, each DSM includes a signaling connection routing controller **334** for controlling overall SCCP functions. One SCCP function that may be called or initiated by SCRC **334** is global title translation function **336**. Global title translation function **336** performs intermediate and final global title translations on received messages indicated as route-on-global title. In order to perform these translations, global title translation function **336** accesses GTT tables **336**. After global title translation, messages are passed to routing function **322** for final routing. Specific examples will be described below where SCCP messages are encapsulated in new SCCP packets and sent to DSMs **306** and **308** for global title translation of the encapsulating SCCP packet. The purpose of global title translating the encapsulating SCCP packet is to send different messages to different services or to perform load sharing. In addition, message redirection and screening may be performed after global title translation, as will be described in detail below.

Figure 5 illustrates exemplary processing at inbound LIM **302** for an incoming ITU ISUP message that triggers message redirection. In the illustrated example, ISUP message **400** is received by LIM **302**. The message is from an ITU OPC and addressed to an ITU DPC. Gateway screening function **314** identifies the message as requiring redirection service. Accordingly, gateway screening function **314** forwards the ITU ISUP message to multi-SS7-variation ID/redirection function **316**.

Multi-SS7-variation ID/redirection function **316** encapsulates ITU ISUP message **400** in the payload portion of an ANSI SCCP message **402**. ANSI

SCCP message **402** is then encapsulated in an ANSI MTP message **404**. Multi-SS7-variation ID/redirection function **316** inserts an SS7 protocol variation indicator identifying the SS7 protocol variation of the payload of the message in the calling party subsystem number field of the encapsulating SCCP message. In this case, the calling party subsystem number would identify the payload as an ITU ISUP message. Accordingly, SCP **202** would know how to decode and process the payload when it receives the message. After inserting the protocol variation indicator in the message, multi-SS7-variation identifier/redirection function **316** forwards the message to discrimination function **318.** Since the encapsulating MTP-3 message is addressed to a DPC associated with SCP **302**, discrimination function **318** forwards the message to routing function **322**. Routing function **322** then routes the message to the card associated with the outbound signaling link.

Figure 5 is a block diagram illustrating exemplary outbound message processing of the SCCP-encapsulated ISUP message. Referring to Figure 5, encapsulated ISUP message **400** is received by outbound DCM **304**. M3UA and SCTP/IP functions **324-332** encapsulate SCCP-encapsulated ISUP message **400** in an SCTP/IP/M3UA message **500**. Once functions **324-332** complete the encapsulation, the message is forwarded to SCP **202** over the appropriate outbound signaling link. Because the message includes an indicator indicating the message type, SCP **202** knows how to decode the message. As a result, SCP **202** can implement ANSI as its external SS7

protocol variation while being able to decode ISUP messages of other SS7 protocol variations.

In an alternate embodiment of the invention, rather than redirecting ISUP messages to a single SCP capable of decoding multiple SS7 protocol variations, multi-SS7-variation identifier/redirection function **316** may configured to encapsulate received messages in an SCCP packet of the appropriate protocol variation and forward the messages to SCPs of the appropriate protocol variation. Figure 6 illustrates a network in which this capability may be useful. In Figure 6, STP **200** is connected to ANSI SCP **600**, and ITU-I ISUP STP **602**, and ITU-N STP **604**. In the examples illustrated in Figure 6, it is assumed that each SCP has a separate point code of the corresponding protocol variation. Alternatively, or in addition, each SCP may have an IP address.

If an incoming ANSI ISUP message is indicated as a candidate for redirection, multi-SS7-variation identifier/redirection function **316** may encapsulate the ANSI ISUP message in an ANSI SCCP message and forward the message to ANSI SCP **600**. If an ITU-I ISUP message is received, multi-SS7-variation ID/redirection function **316**, may encapsulate the message in an ITU-I SCCP message and forward the message to ITU-I SCP **602**. If an ITU-N message is received, multi-SS7-variation identifier/redirection function **316** may encapsulate the message in an ITU-N message and forward the message to ITU-N SCP **604**. Thus, by identifying the SS7 protocol variation and redirecting

messages to the appropriate SCP, the present invention ensures that messages will be decoded properly.

The present invention is not limited to identifying the protocol variation of received ISUP messages and redirecting these messages to the appropriate SCP. In an alternate embodiment of the invention, multi-SS7-variation ID/redirection function **316** may be configured to redirect SCCP messages as well as ISUP messages. In performing SCCP message redirection, multi-SS7-variation ID/redirection function **316** may encapsulate the messages in an SCCP and MTP headers addressed to STP **200**. The translation type and the global title address in the SCCP header may be the same for all SCCP message if only one service type is provisioned for redirected messages. Alternatively, if multiple service types are provisioned, multi-SS7-variation ID/redirection function **316** may map the OPC and DPC in an incoming message to appropriate translation type so that the messages requiring different services will be global-title-translated differently and routed to a node capable of providing the requisite service. Once SCCP-encapsulated SCCP messages are received by a DSM module, the DSM module performs global title translation on the encapsulating SCCP header. The result of the global title translation is a point code and subsystem number, which may correspond to one of the SCPs connected to STP **200**. Accordingly, the multi-SS7-variation identification and redirection functionality of the present invention can apply to received SCCP messages, as well as ISUP messages.

In addition to performing multi-SS7-variation identification and redirection processing on the inbound link interface module, the present invention may also include performing such screening on the DSM module after global title translation. Performing multi-SS7-variation identification and verification after global title translation increases the likelihood that messages will be properly redirected based on the global-title-translated destination point code.

Although the embodiments described above relate to redirecting messages of different SS7 protocol variations to an SCP, the present invention is not limited to redirecting messages to an SCP. Redirecting messages to any suitable application, including applications resident on an SCP, is intended to be within the scope of the invention.

Thus, the present invention provides methods and systems for identifying, redirecting, and processing messages of multiple different SS7 protocol variations. Identifying the protocol variation of a received message and communicating the variation to an SCP allows an SCP that communicates externally using one SS7 protocol variation to process messages of multiple different SS7 protocol variations. Without the ability to identify the SS7 protocol variation of a received message, such an SCP would simply discard messages of protocol variations other than its native protocol variation. The present invention avoids this problem and thus increases the likelihood that calls will be competed.

It will be understood that various details of the invention may be changed without departing from the scope of the invention. Furthermore, the

foregoing description is for the purpose of illustration only, and not for the purpose of limitation, as the invention is defined by the claims as set forth hereinafter.